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# INDUSTRIAL DISEASES

BY PAUL S. PEIRCE

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INDUSTRIAL diseases have been defined as “ morbid results of occupational activity traceable to specific causes or labor conditions, and followed by more or less extended incapacity for work.” They are, of course, by no means a modern phenomenon; of the processes known to us, some of the most injurious are extremely ancient. But scientific and popular attention to such maladies with a view to minimizing or eliminating them is decidedly modern. Professor Ramazzini, of Padua, and some of his seventeenth-century contemporaries raised prophetic voices; but genuine medical interest in industrial diseases can hardly be said to antedate the nineteenth century in Europe, and in this country one of the earliest contributions to the subject appeared in 1879. Anything like general popular or scientific interest in the matter here is largely the growth of the past decade. That that growth has been increasingly rapid there is no room to doubt. The American Association for Labor Legislation specialized on the subject at its last annual meeting; a National Conference on Industrial Diseases has been held in Chicago; an Illinois State special Commission on Occupational Diseases appointed by Governor Deneen recently submitted its report—a unique document in this field of State investigation; the United States Bureau of Labor has issued several valuable monographs on various phases of the subject; in fact, the literature of the subject is bulking fast; and a committee of experts recently memorialized President Taft, urging the necessity of Federal action. But despite all this progress, we still must go to Europe for comprehensive data, for most modern treatises on industrial hygiene, for models of legislative measures of amelioration.

This awakening in Europe and America to the urgency

of the problem of industrial diseases is to be ascribed to a variety of causes. In some measure to changes in the methods and organization of modern industry; to the added physical strain which comes with concentration, specialization, and growth. Still more to a larger knowledge of the causes and treatment of disease, it is a chapter in preventive medicine. And quite as much, to a truer appreciation and appraisal of economic and social values, it is a chapter in the conservation of human resources. But not least of all, to a growing sense of social responsibility for much of human suffering and for the human costs of modern industry, it is, in one aspect, a chapter in the general health movement of our time, and next of kin to the crusade against tuberculosis, infant mortality, hook-worm, and typhoid, and the campaign for a national health department. In another aspect, it is part and parcel of the movement for labor legislation, being intermingled with the programme of child-labor reform, factory legislation, and factory inspection, and standing as the counterpart of measures for the compensation of industrial accidents. And, like all these projects, it reflects an enlarged conception not only of the social function of the physician, but of the protective function of the government itself.

The classification of industrial diseases is not a perfectly simple matter, for the boundaries of the field are at some points indistinct, the number of maladies clearly falling within the field is very great, and the possible bases of classification numerous and clashing. Let us adopt causal conditions as a basis, and in turn take up and illustrate a number of causal groups.

It has long been recognized that exposure to extremes of heat or cold or to sudden changes of temperature predisposes to certain diseases; perhaps equally serious in its consequences is extreme humidity, and doubly menacing are conditions which combine both evils. From the many occupations which involve exposure to such adverse atmospheric conditions we may select three as typical—glass-blowing, cotton spinning and weaving, and pork trimming in packing-houses. For many years glass factories were so poorly constructed as to afford little protection to workmen, who were chilled on one side by icy blasts of winter and scorched on the other by glaring furnaces. Blowers whose bodies were bathed in perspiration stood with cold feet on the bare ground, which was sodden with water splashed thereon when

the pipes were being cooled. In later years construction of factories has been much more satisfactory, and liability to disease has been lessened accordingly. But a new menace has come through the substitution of the "continuous tank furnace" for the old "pot furnace"; this is much larger, and so subjects the worker to greater heat, and it is operated night and day, and the alternation of day and night work reduces the worker's power to resist disease. When to these conditions are added the negligence and lack of precautions of the glass-blowers themselves upon going from a working temperature of 100 degrees to 130 degrees out into the winter's zero atmosphere, it is little wonder that pneumonia, inflammation of lungs and throat, bronchitis, and *la grippe* make up the overwhelming majority of the ills of glass-workers. And to these are to be added an inflammation of the eyes, which leads to progressive dimness of sight, and which is traceable to exposure to the heat and glare of the furnace.

One of the most serious problems in the spinning and weaving departments of a cotton factory is the preservation of the proper relative proportions of heat and humidity. As cotton fibers when too dry are brittle and do not "run" well, artificial humidity is necessary. The finer grades, which require more heat and moisture than the coarser grades, must be drawn, spun, and woven in exceedingly warm and humid atmosphere. At what point abnormal moisture becomes a menace to the worker is an unsettled question. It is believed that much of the danger comes from sudden transition to the normal outer air, and thence perhaps to the still drier atmosphere of the sleeping-quarters, and that these changes make the workers especially susceptible to pulmonary, bronchial, and catarrhal affections. At any rate, it is significant that Massachusetts has enacted that the humidity in such departments shall be determined, recorded, and regulated, and that it shall not exceed certain statutory limits.

As involving exposure to moisture and extreme cold may be cited the trimming-rooms of packing establishments, where, in the words of Miss McDowell,

"The walls are running with cold sweat and the floor is covered with water, where the temperature is thirty-eight degrees Fahrenheit, colder than an ice-box, and where girls who trim the pork for the sausage must work ten hours a day."

Certain occupations associated with loud noises produce permanent injury to the ear. These are chiefly those of locomotive firemen and engineers, boiler-makers, bridge-builders, ship-builders, and other structural iron and steel workers, artillerymen, and weavers. Boys frequently lose their hearing while they are yet apprentices to boiler-makers and riveters; and the extent of impairment of hearing in these various trades is surprisingly great. Such deafness constitutes a serious handicap for engineers and firemen, and a great inconvenience, if a less serious handicap, to other workers.

Caisson disease is the most notable example of diseases of occupations involving abnormal air pressure. It occurs in such occupations as diving, tunnel and bridge construction, and occasionally the erection of buildings. Men who dig deep into the bed of a river or bay to build supports for bridges do their work in iron cylinders, or caissons, into which compressed air is forced in sufficient volume to prevent caving while the work of construction is in progress, and to keep the water from running in at the bottom while dirt is dug up and carried to the top. This means an increase of atmospheric pressure from the normal fifteen pounds to two or three times that amount. The mere compression does not usually have serious effects upon the normal individual; indeed, it seems to bring a feeling of exhilaration. Like some of the rest of us, the "sand hog," as the caisson-worker is called, works best under pressure. But decompression, or return to normal pressure, is far more important. Almost all cases of disease originate in too rapid reduction of pressure, and symptoms develop after normal pressure is reached. The most common phenomena are severe pains in the limbs, called the "bends"; vertigo, known as the "staggers"; and more rarely dyspnea, or the "chokes," which may be accompanied by rushing of blood from eyes, ears, and nose; sometimes paralysis of lower limbs and other serious nervous disturbances which may prove permanent. Before modern precautions became general, death after emergence from caissons was a frequent occurrence. When the Eads Bridge was built at St. Louis 600 men were employed in sinking foundations, and of these 110 suffered from this disease, and 14 died. As to the prevalence of the disease to-day, no statistics are available; but the Illinois Commission traced nearly 150 cases known to

have occurred in that State within the last twenty years, some of which resulted in complete recovery and others in permanent disability.

Authorities are agreed as to certain precautions necessary to minimize the dangers from compressed-air work. Among them are medical inspection to determine the physical fitness of men for this hazard; regulation of the length of shift and of the time for decompression; keeping the air warm in the lock during decompression; a warm place for changing clothes after coming out of the lock; abundant supply of air in the caisson; and a hospital lock for recompression in case of attack. Provisions for such safeguards have been embodied in the laws of New York State and of various foreign countries, and are recommended by the Illinois Commission.

Certain diseases are associated more or less closely with occupations involving constrained attitudes or over-exercise of certain parts of the body. Such occupations were not all ushered in by the industrial revolution. Indeed, with the new order some of the occasion for the old constraint has passed away. But it is hard to believe that, on the whole, constraint of position has not grown more serious with the increasingly minute subdivision of labor, with the narrowing of the toiler's day to an infinite repetition of one or two simple movements, and with the harnessing of the worker to the machine. In this connection one is reminded of the locomotive fireman who, upon being asked how many times he bent his back during his daily run, replied, "Just once"; the rest of the story is in the vital statistics of his order. Coal-miners are subject to a disease of the eyes called nystagmus, whose most striking characteristics is a rotary movement of the eyeballs, varying in rapidity from 60 to 350 movements per minute. This disorder is directly traceable to the constrained position assumed by miners in "holing" the seam at the coal face.

"A man sits with his legs crooked up, lying almost on his side, and strikes the coal with a horizontal swing of the pick. His eyes follow the pick point, but the tendency is to gaze upward more or less obliquely. His head is thrown back and flexed more or less on the shoulder beneath."

The reason for assuming this unnatural position is to get the coal out in larger pieces, because miners have frequently been paid only for coal which would pass over a screen of a certain size. Nystagmus is now said to be rare,

and for two reasons: First, the substitution of machine mining for picking mining; and, second, the enactment of gross-weight laws requiring mine owners to pay for the entire quantity mined, not simply for the larger lumps—an interesting illustration of what improved processes and enlightened legislation may do, even unwittingly, to ameliorate conditions making for industrial disease.

Certain diseases are associated with occupations involving exposure to industrial poisons—*i. e.*, to substances which endanger by chemical processes the working capacity of the laborer. Such substances may enter the body through the mouth and digestive system, through the respiratory system, or through the skin. The extent of the danger from industrial poisons has not been accurately determined in any country, but the International Association for Labor Legislation has published a list of some thirty or forty substances, giving the characteristics of each, the industries in which they are prepared or used, the mode of entrance to the body, and the symptoms of poisoning in each case. Among the first to receive thorough investigation in this country and in Europe were phosphorus poisoning and lead poisoning.

Phosphorus poisoning is pre-eminently the menace of the American parlor-match industry. The head of the ordinary parlor match is made by dipping one end of the wooden splint into a paste containing a small per cent. of white (or yellow) phosphorus, a deadly poison. All who have to do with mixing this paste, dipping the splints, or drying and packing the matches, are exposed more or less to its dangers. Unless ventilation is good, and unless extraordinary precautions are taken with respect to factory and personal hygiene, fumes or particles of the phosphorus are likely to enter the body. The evil effects of such poisoning are in general anemia, lowered vitality, and predisposition to other diseases, and in some cases “phossy jaw” (phosphorus necrosis), a disease caused by absorbing phosphorus through the teeth or gums. Minute particles enter perhaps through cavities in the teeth, an irritation is set up which extends to the jaw, the teeth may loosen and drop out, the jaw decompose, and the disease communicate itself to the whole system. When once established, only a serious surgical operation, perhaps the removal of the jaw-bones, can arrest the progress of decay. It is to such a loathsome

affliction that sixty-five per cent. of all workers in American match factories are liable; and among women and children employed in such establishments the percentage is far higher. and the pity of it is that such suffering should continue when it is preventable through the substitution of harmless phosphorus, and that the United States should continue to exact this toll when almost all civilized nations have already forbidden the use of white phosphorus! The substitute is slightly more expensive, and until recently has been controlled through patent by a well-known company. But that company was induced to cancel the patent some months ago, so that the harmless process is now available to the whole match industry. A bill was also introduced in Congress providing for the taxing of white phosphorus so heavily as to render its use uneconomical, but the passage of this measure, so urgently needed, is one of the many things the last session of the Sixty-first Congress failed to accomplish.

Lead poisoning was made the chief objective of the Illinois Commission on Occupational Diseases. They discovered in that State twenty-eight industries in which this form of poisoning is a factor; but the great majority of cases were chargeable to five industries, *viz.*, white-lead manufacturing, lead smelting and refining, making storage batteries, making dry colors and paints, and the painters' trade. The last was found to be numerically the most important lead trade in the State of Illinois, employing probably 30,000 men. Its workers acquire lead poison for the most part through chewing lead-smeared tobacco, eating lead-smeared food, breathing dry lead dust, mixing dry white or yellow lead with putty or paint, and especially sand-papering coats of lead paint after they are dry. The hazard of this occupation might be greatly diminished, it is believed, by greater care on the part of painters, by provision of warm rooms in which they may wash their hands, change their clothes, and eat their lunches, as in Germany; by abolishing the use of white-lead paint, as in France, or by using it only for exterior work, and by doing away with *dry* sand-papering of lead paint, as in England. Indeed, it is contended that the lead trades in general are more dangerous here than in England or Germany. Their evils, it is true, tend to lessen with the substitution of machinery for hand work and with other alleviation of conditions; but the improvements in the



care of the men do not keep pace with improvements in mechanical processes.

The importance of dust as a factor in occupation mortality has been emphasized by all writers since the days of Ramazzini. In fact, so strongly has it impressed them that they have singled out a large and growing number of employments for separate treatment under the caption "Dusty Trades." The reason for this is obvious when the insaniary possibilities of dust-laden air are considered. Not only may the dust be laden with poisonous particles, but it may bear the germs of infectious diseases—some peculiar to the human family, and others, like anthrax, transmissible from animals to men. These germs are the chief hazard of rag-sorting, wool-sorting, hide-handling, hair and brush manufacturing, and a score or more of related trades. But quite apart from its infective or poisonous character, industrial dust is injurious because of its mechanical properties. It impairs the lungs and the delicate membranes of the air passages, and goes far to explain the abnormal consumption death rate among workers in the dusty trades.

"The destructive influence varies according to the amount of dust, the kind of dust, the constancy of its presence, the susceptibility of the individual, and the methods employed to protect the individual against the entrance of the dust into the human organism."

The mechanical effects of organic dusts such as prevail in milling, tobacco and snuff manufacturing, textile industries, and comb and button factories are regarded as less injurious than the mineral and metallic dusts. Stone and marble cutters, glass-cutters, diamond-cutters, potters, cement-workers, plasterers, molders, and others exposed to mineral dusts show abnormally high death rates, especially from respiratory diseases, that from consumption being about five times as high among stone and marble cutters as among farmers and farm laborers. Still more serious is the exposure to metallic dusts which characterizes the work of metal-grinders, polishers, tool and instrument makers, brass-workers, jewelry-workers, printers, and engravers, and so on. Conspicuous above the rest as a sufferer from metallic dust is the grinder of tools, and especially the grinder of such small objects as forks and needles, who employs the dry method and who, because of the smallness of the objects, leans close over the stone, and so inhales much dust.

The extent of industrial diseases in the United States is

as yet quite an unknown quantity, and the possibilities of their prevention we are only beginning to appreciate. The whole subject is comparatively new here. The serious effects generally observed have been looked upon as inevitable incidents of indispensable industrial processes. Many employments have never been made the subject of proper inquiry. And all attempts at competent investigation have been hampered by lack of satisfactory standards of industrial life and health and adaptability to trades; by the absence of sickness statistics such as are furnished by the government insurance institutions of continental Europe, and by the annoying limitations of our mortality statistics. In the first place, only the immediate occasion of death is given, and no light is thrown upon predisposing causes. For example, lead absorbed into the system compasses the death of a painter, but the death certificate is probably returned not as industrial poisoning, but under some more general title denoting the fatal cause. Industrial dust predisposes to tuberculosis, but mortality statistics make no distinction between industrial lung diseases and those attributable to other causes. Moreover, mortality statistics are given by industries, not by specific employments within an industry. Now some employments within an industry are much more wholesome than others; and the student of industrial diseases is primarily interested, not in the mortality statistics of the glass industry as a whole, for instance, but in the mortality statistics of glass-blowers, clay-grinders, melters, and other specific employments within that industry. In the third place, statistics are often misleading because of the shifting of workers from one industry to another; for example, a worker in a white-lead factory shows signs of poisoning and is advised to quit the employment; his death results from lead work, but statistics will charge it to some other occupation.

In the absence of adequate statistics and research, the actual amount of sickness and death among the industrial population must be a matter of "scientific conjecture." With German sickness insurance experience as a basis, Dr. F. L. Hoffman, of the Prudential Insurance Company, has attempted an estimate of the amount and cost of sickness among our industrial workers in 1910. Placing the number of persons gainfully employed at 33,500,000, and assuming the same sickness rate as is found in Germany, he finds

that the number of cases of sickness among these workers last year must have been 13,400,000, the aggregate number of days of sickness 284,750,000; the loss of wages not less than \$366,107,145; the medical cost \$284,750,000, the loss through change of workers in industry on account of sickness \$122,035,715, making a total economic loss among the industrial classes of \$772,892,860 for the year. Of this total, German experience indicates that no less than one-fourth is due to strictly preventable causes, a needless waste of \$193,223,215. In fact, it is thought that the sickness rate here is somewhat higher than in Germany, and consequently that the above estimates are too low. Moreover, these figures take no account of permanent invalidity and excessive mortality involved in present industrial conditions; and Dr. Hoffman places the number of deaths among American wage-earners last year at 330,500, of which no less than one-fourth were clearly preventable. Nor do any of these figures take account of the handicap which industrial disease and premature death imposes upon the posterity of the worker.

How shall this immeasurable waste be checked? How shall our law, our science, and our humanity be brought to bear effectively upon this great problem in conservation of human resources? In their memorial to President Taft, the committee of the National Conference on Industrial Diseases urged three steps on the part of the Federal Government: First, the appointment of a national commission of inquiry, constituted of Senators, Congressmen, and experts in preventive medicine, medical practice, sanitary engineering, industrial chemistry, and applied statistics, and charged with the comprehensive investigation of the whole subject of occupational diseases; second, the establishment of a national institute of industrial hygiene equipped for research into the causes and treatment of factory diseases and designed to carry out proposals of the national commission, publish results, and give encouragement to the pursuit of industrial medicine as a distinct profession; third, the creation of a national welfare institute for the improvement of labor conditions, including a "museum of safety devices whereby the calamities of industrial life may be lessened and the ravages of industrial disease diminished."

This threefold national programme is confessedly ambitious, and its full realization must await development of sentiment. It may have to await the organization of a na-

tional health department. And meanwhile the national government is called upon to adopt such unambitious measures of amelioration as the taxing of white phosphorus out of the match industry—measures whose success is pre-assured if they can be brought within the scope of the Federal functions of taxation and trade regulation. But under our dual constitutional system we must still rely for the most part upon the individual States for action in the interests of industrial health. In the progress of general labor legislation is our first hope—in factory codes which provide more and more perfectly for lighting, ventilation, dust removal, personal and shop cleanliness, and efficient inspection. The medical inspector of factories who has appeared and found status in Massachusetts and a few other States should be a conspicuous member of the staff of inspectors in every State in the Union; for, in the words of Dr. W. C. Hanson,

“Medical men alone are in a position to make the best use of facts obtained concerning the sanitary conditions of the premises where men and women work; to study the possible injurious effects of certain processes upon the health of the person engaged therein; to inspect devices designed to protect the employees against injurious and dangerous substances, as well as to detect pathological signs or symptoms of certain poisons and dusts and fumes incident to some occupations; to inquire as to the health of the employees; to make physical examination of minors, and, whenever possible, of adults, engaged in trades deemed to be injurious to health; and to collect and make proper use of all facts and data, including morbidity and mortality statistics pertaining to occupational hygiene.”

Experts have also urged that special clinics be established for the study of industrial disease; that medical practitioners be required to report to the State factory inspector all cases of industrial diseases, as they are now required to report to the health authorities communicable diseases like scarlet fever and diphtheria; that employers in certain industries be required to employ (as many now do voluntarily) approved physicians who shall examine workers at stated intervals with especial reference to symptoms of diseases to which the trade renders them especially liable, and that employers be obliged to keep a careful record and report by causes and occupations all cases of industrial injuries so discovered. The pioneer work of the Illinois Commission on Occupational Diseases will no doubt stimulate similar and more comprehensive investigations in that and

other States. It is to agencies such as these—to commissions, clinics, medical inspectors, and compulsory examinations and reports—and to the wide-spread publicity of their findings, that we must look for guidance toward the prevention of unnecessary industrial disease.

But, like industrial accidents, these diseases, in as far as they are not prevented, raise grave questions of liability and compensation. Indeed, not only do the two closely parallel each other, but industrial diseases shade off imperceptibly into industrial accidents. There is no sharp line of demarcation, nor is there any fundamental difference in the basis of industrial responsibility, except that the cause of the disease may be more obscure than that of the accident. When England passed her workmen's compensation act of 1906 she included in her classification six industrial diseases; the list has since been extended to twenty-seven. In other European countries the principle is now firmly established that a workman is entitled to compensation if incapacitated by a disease contracted in his trade and due to his employment, exactly in the same way as if he had been disabled by an accident. Our own States must find this the inevitable conclusion as soon as they have become committed to the principle and policy of workmen's compensation.

It is clear that with a programme of inaction we must not be content. We may not expect occupational immunity from disease, but we should set before us as a goal a minimum of hazard and hardship to the worker and a minimum of waste of human resources. Our watchword should be the *facts* and their *publicity*, to the end that industrial diseases may be prevented so far as possible and equitably compensated when not prevented.

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